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SCIENTIFIC AFFAIRS

No. 584

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33

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BULGARIA

PROGRESS IN LASER TECHNOLOGY DEVELOPMENT

Sofia OTECHESTVEN FRONT in Bulgarian 10 Mar 78 pp 1, 3

[Article by Zakhari Nikolov: "This Miracle, the Laser, Is Extensively Entering our Lives"]

[Text] The discovery of lasers and their comprehensive utilization are among the greatest accomplishments of physics in the second half of the 20th Century. The radical changes in the development of our science under the people's system legitimately led to successes in the field of laser technology in Bulgaria.

This was the reason for our visit to the specialized quantum electronics laboratory of the physics department of Kliment Okhriski Sofia University. Many of the scientific workers are students of the now deceased Soviet scientist academician Rem Viktorovich Khokhlov, Moscow University Rector and deputy chairman of the USSR Academy of Sciences. Docent Konstantin Stamenov, head of the quantum electronics laboratory remembers him with warmth and gratitude. Over 10 years ago he and, later, other Bulgarian physicists working in this field, were assigned to specialize at Moscow University. Here close contacts with the great Soviet scientist were the initial steps in our laser technology.

"It seemed to us that it may have been too early to begin studies in the field of lasers," said Docent Stamenov. "We had almost no material facilities or adequate experience. However, academician Khokhlov gave us the confidence that we could and should do everything possible for the development of Bulgarian laser technology."

This was followed by initial attempts with successes and failures. Today, however, the positive results are already obvious. The laboratory has mastered methods for transforming the wavelength of the laser light impulse from the infrared radiation zone to the range of ultraviolet rays. Lasers are being used providing very short light pulses. Why is this needed? The practical application of lasers requires, above all, knowledge of what could be obtained with their help and how.

The power of light radiation contained in the laser beam is tremendous. It has been established that a single laser beam could carry up to one million television programs. Naturally, in order to achieve this we must master the method for coding and decoding the information carried by the beam. Along with achieving super short radiation, the laboratory has developed holographic equipment for three dimensional photographs. Holograph equipment makes possible to see the studied matter, object, or process in its actual three dimensional sizes. In other words, in the immediate future the physicians will be able to conduct their observations on the human body with something resembling an x-ray photograph but three dimensional. Holography can also be used to control extremely small movements of bodies, and minor deformations in machine and engine vibrations (under 1,000th of a millimeter). It can be successfully used for the detection of images in criminal studies, the comparison of details, and so on. In the future it will be applied as a method for computer data processing.

"The possibilities of laser beams are exceptionally great," said Docent Tomov, another alumni of the laboratory headed by academician R. V. Khokhlov and Professor Dr. S. A. Akhmanov. "The exceptionally precise focusing of the beam and the control of its intensity make possible a number of fine operations which are impossible any other way. For example, a laser beam enables us to weld metal of different qualities and great melting temperature disparities."

In another laboratory we were shown metal-ceramic plates with almost invisible apertures. Few people know that it is precisely through such apertures that fine capron and polyamide fibers are spun for fine fabrics used in the textile industry. The Textiles and Textile Fibers Department of the Higher Chemical and Technological Institute in Sofia has been successfully experimenting with this new development. It will be applied in the plans which will use Bulgarian ceramic plates instead of imported expensive and undurable platinum ones. Laser beams will eliminate some minor defects in integrated circuits. Fine films used in microelectronics can be processed with lasers. Laser beams clean the tips of special imported needles for welding the leads of integrated circuits at semi-conductors plant in Botevgrad. A technology for fine tuning of quartz resonators has been developed used, for example, in the new Bulgarian time pieces. This also could be accomplished with a laser beam. Another interesting application of the laser beam is the possibility for surface spot heat welding of undurable cutting metal parts. This avoids the overall tempering of such parts, thus eliminating the danger of making them brittle. Methods and equipment are being developed for fast and remote control study of the composition and pollution of large water basins such as rivers, lakes, seas, and industrial water--with the help of lasers.

The use of lasers in medicine and, particularly, in surgery is very promising. A laser beam could be used as a scalpel for fine tissue cuts without affecting blood vessels, such as, in eye operations, in putting back a separated retina, in brain operations, and so on. A laser could even separate an individual cell.

Such is the comprehensive and very practical application of lasers in laboratories. It is quite clear that the possibilities offered by laser technology in our country and throughout the world are tremendous and that lasers will be used ever more extensively in all fields of science and human life.

5003
CSO: 2202

BULGARIA

UDC 621.382.2

SPECIFICATIONS OF BULGARIAN SILICON PULSE DIODES

Sofia RADIO, TELEVIZIYA, ELEKTRONIKA in Bulgarian No 1, 1978 p 32 and both sides of back cover

[Article by Engineer T. Moskov and Engineer G. Kondarev: "Silicon Pulse Diodes"]

[Text] Designed for use in computer technology, radioelectronics and industrial electronics. Produced at the semiconductor plant in Botevgrad.

2D5605, 2D5606.

Case: S64.

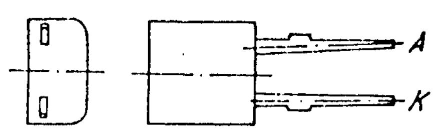

Figure 1.

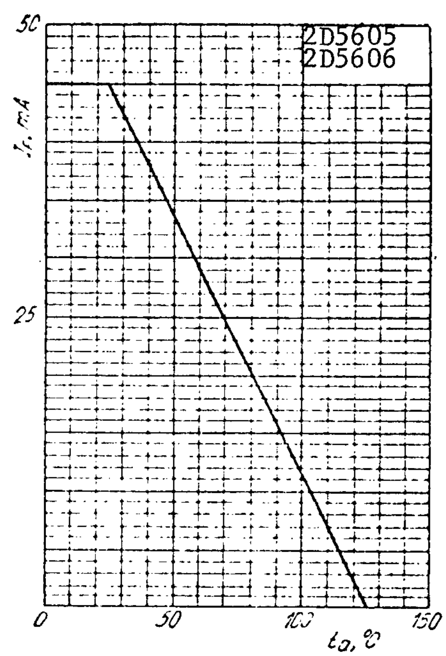

Figure 2. Direct forward current as a function of ambient temperature.

Table 1

Maximum Permissible Parameters

		2D5605	2D5606	
(1) Постоянно обратно напрежение	U_{Rmax}	20	40	
(2) Импулсно обратно напрежение	U_{RRMmax}	22	43	
(3) Постоянен ток в права посока	I_{Fmax}	45	45	mA
(4) Среден изправен ток	I_{omax}	45	45	mA
(5) Импулсен ток в права посока	I_{FRMmax}	250	250	mA
(6) Температура на прехода	t_{jmax}	125		°C
(7) Температура на съхранение	t_{stg}	—35 to +125		°C

Key:

1. **Constant inverse voltage**
2. **Pulse inverse voltage**
3. **Direct forward current**
4. **Mean rectified current**
5. **Pulse forward current**
6. **Junction temperature**
7. **Storage temperature**

Table 2

Principal Parameters at $t_a = 25^{\circ}$ C

			2D5605	2D5606	
Постоянно напрежение в права посока (1) $I_F = 10$ mA	U_F	max	1	1	V
Постоянен обратен ток (2) $U_R = 20$ V	I_F	max	1		µA
$U_R = 40$ V		max		1	µA
Капацитет на диода (3) $U_R = 0$, $f = 1$MHz	C_{tot}	max	4	4	pF
Време за възстановяване на обратното съпротивление (4) $I_F = 10$ mA, $U_R = 6$ V; $i_{rr} = 0{,}1\ I_F$, $R_2 = 100\ \Omega$	t_{rr}	max	5	5	ns
Импулсно напрежение в права посока (5) $I_F = 100$ mA, $t_u = 300$ µs	U_{FSM}	max	1,5	1,5	V

[Key on next page]

Key to Table 2:

1. Constant forward voltage
2. Direct inverse current
3. Diode capacitance
4. Reverse recovery time
5. Pulse forward voltage

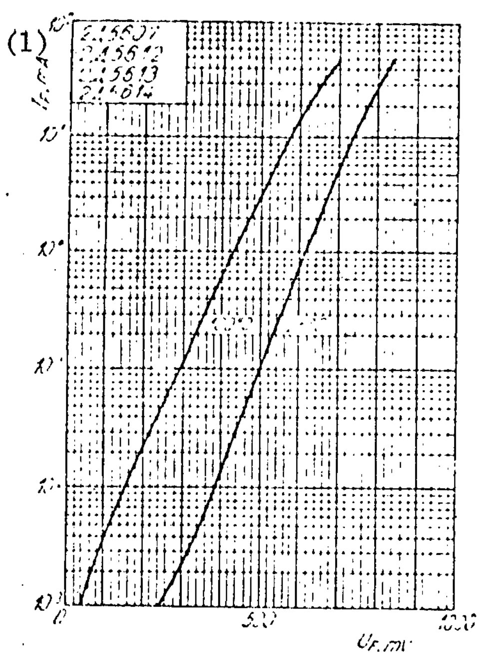

Figure 3. Constant forward voltage as a function of direct forward current.

Key:

1. 2D5607, 2D5612, 2D5613, 2D5614

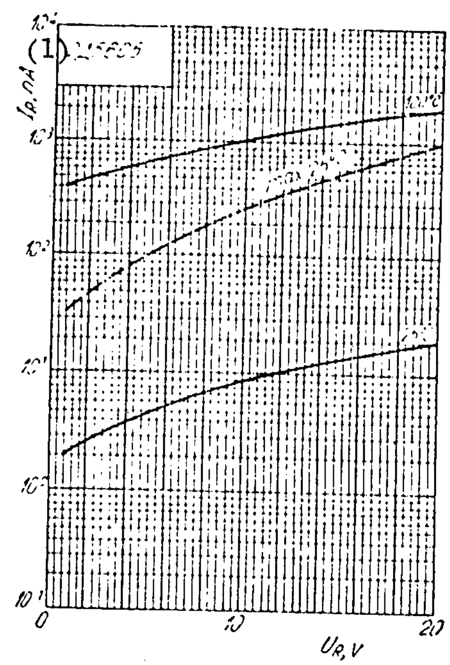

Figure 4. Direct inverse current as a function of constant inverse voltage.

Key:

1. 2D5605

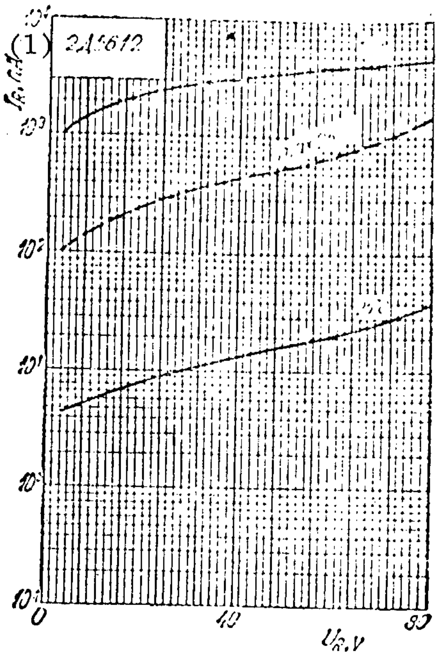

Figure 5. Direct inverse current as a function of constant inverse voltage.

Key:

1. 2D5612

Table 3

Maximum Permissible Parameters

		2D5607	2D5612	2D5613	2D5614	
Постоянно обратно напрежение (1)	U_{Rmax}	60	80	100	110	V
Импулсно обратно напрежение (2)	U_{RRMmax}	70	35	105	115	V
Постоянен ток в права посока (3)	I_{Fmax}					
Среден изправен ток (4)		50	50	50	50	mA
Импулсен ток в права посока (5)		50	50	50	50	mA
		250	250	250	250	mA
Температура на прехода (6)		125				°C
Температура на съхранение (7)		—55 to +125				°C

Key:

1. Constant inverse voltage
2. Pulse inverse voltage
3. Direct forward current
4. Mean rectified current
5. Pulse forward current
6. Junction temperature
7. Storage temperature

Table 4

Principal Parameters At $t_a = 25^{\circ}$ C

			2D5607	2D5612	2D5613	2D5614	
Постоянно напрежение в права посока (1) $I_F = 10$ mA	U_F	max	1	1	1	1	V
Постоянен обратен ток (2) $U_R = 60$ V	I_R	max	1				μA
$U_R = 70$ V		max		1	1	1	μA
Капацитет на диода (3) $U_R = 0$, $f = 1$ MHz	C_{tot}	max	4	4	4	4	pF
Време за възстановяване на обратното съпротивление (4) $I_F = 10$ mA, $U_R = 6$ V; $i_{rr} = 0{,}1\ I_F$, $R_2 = 100\ \Omega$	t_{rr}	max	5	5	5	5	ns
Импулсно напрежение в права посока (5) $I_F = 100$ mA, $t_u = 300$ μs	U_{FSM}	max	1,5	1,5	1,5	1,5	V

Key:

1. Constant forward voltage
2. Direct inverse current
3. Diode capacitance
4. Reverse recovery time
5. Pulse forward voltage

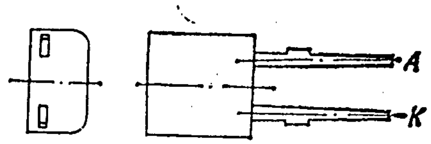

Figure 6.

2D5607, 2D5612, 2D5613, 2D5614.

Case: S64

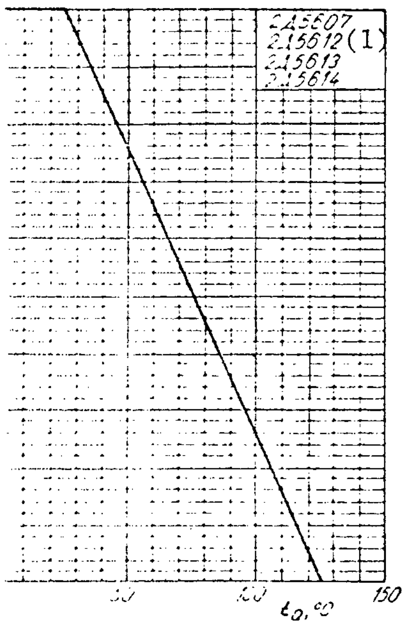

Figure 7. Direct forward current as a function of ambient temperature.

Key: 1. 2D5607, 2D5612, 2D5613, 2D5614

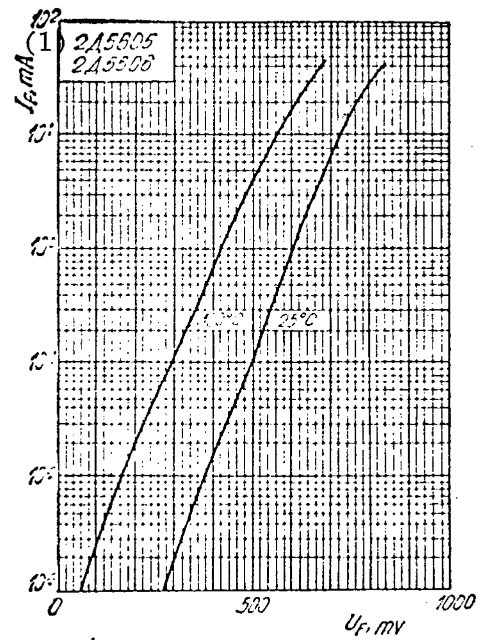

Figure 8. Constant forward current as a function of direct forward voltage.

Key: 1. 2D5605, 2D5608.

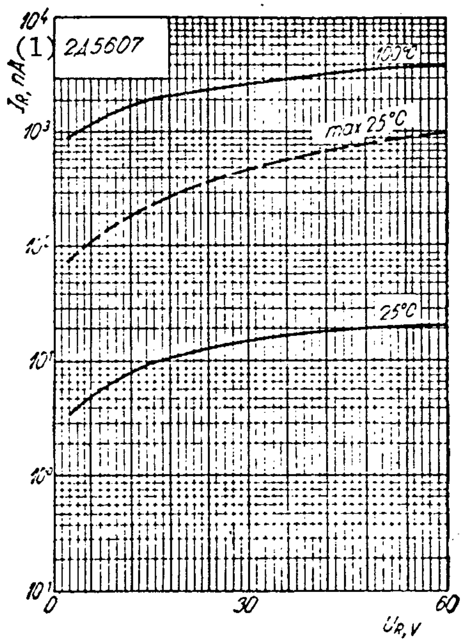

Figure 9. Direct inverse current as a function of constant inverse voltage.

Key: 2D5607

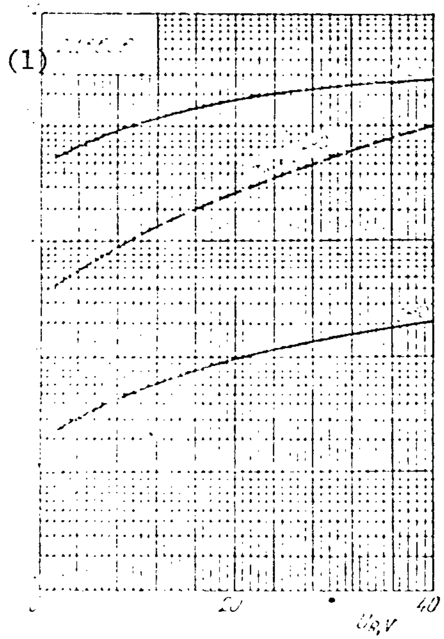

Figure 10. Direct inverse current as a function of constant inverse voltage.

Key: 1. 2D5606

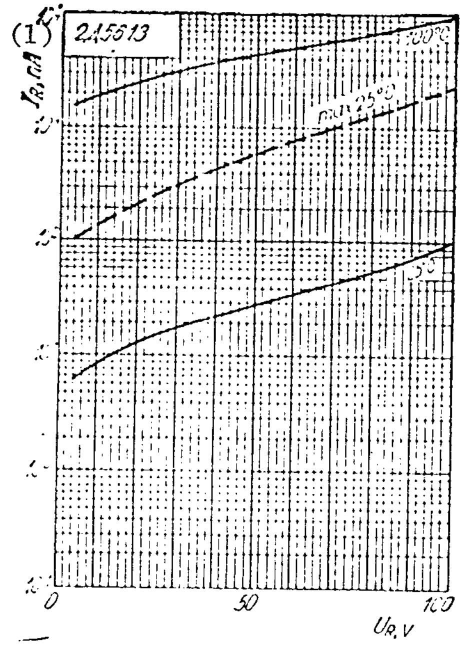

Figure 11. Direct inverse current as a function of constant inverse voltage.

Key: 1. 2D5613

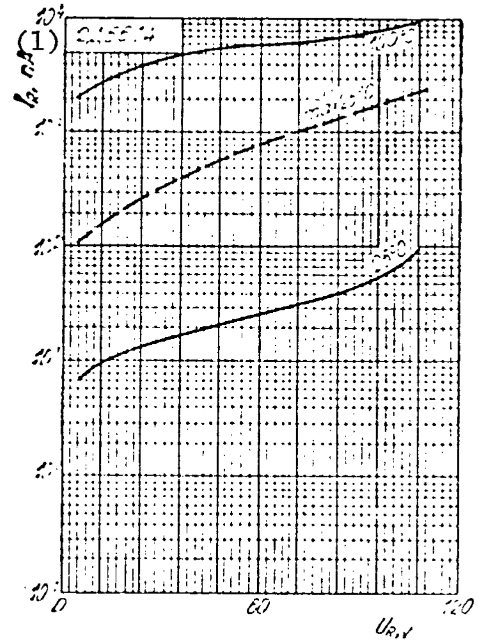

Figure 12. Direct inverse current as a function of constant inverse voltage

Key: 1. 2D5614

6474
CSO: 2202

SCIENTISTS, INSTRUMENTS AT DUBNA NUCLEAR RESEARCH INSTITUTE DESCRIBED

Budapest NEPSZABADSAG in Hungarian 14 Apr 78 p 4

[Article by Gyula Kekesdi dated "Dubna, April 1978"]

[Text] My guide in the synchrocyclotron building (which houses the oldest particle accelerator in the United Atomic Research Institute (UARI) at Dubna) is a tall, young, sympathetic Hungarian scientist. He explains that the accelerators, these complex installations, are the bases of research. The effects of the particle beams, emerging from several channels, answer the scientists' questions. He praises the monstrous machine which was once the world's largest accelerator.

In the early fall of 1956 I heard the late Veksler academician, one of the great personalities of the recently opened UARI at Dubna, say that Dubna was created so that the scientists of the socialist countries could participate in atomic physics research which has such a large role in science. Presently, 74 percent of the costs are borne by the USSR and 26 percent by the other partner countries. Hungary's share is 2.6 percent.

The institute on the bank of the Volga, 130 km. from Moscow, grew into a town by now. There are scientists from 11 countries here and 48 of them are Hungarian. The director of the UARI is N.N. Bogolyubov, Soviet academician. The two deputy directorships rotate among the other countries. One of them is presently a Hungarian, Dezso Kiss academician who directs the high-energy research and international contacts.

"There are 6000 employees here, of whom 800 are researchers" says the deputy director. The work is done in six scientific laboratories and one department. By size, these are essentially equivalent to an independent research institute. At least one of the deputy directors of the laboratories comes from the partner countries; presently Laszlo Cser and Janos Ero, in the neutron physics and nuclear laboratories, respectively, represent Hungary. Our compatriots filled responsible positions in the past also; e.g. Norbert Kroo and Zoltan Zamori were excellent deputy directors.

The majority of our delegates work in Hungarian groups which adds to the effectiveness. Such groups operate in the neutron physics, nuclear, and

high-energy laboratories. Hungarian participation is also significant in the theoretical physics laboratory and a few of our scientists work alone on their subjects.

Gyorgy Szentes, the leader of the Hungarian delegation tells me that Dubna engages in particle physics, nuclear physics, and neutron physics research. All these need an expensive, large apparatus, an accelerator or a reactor. The conditions for research are best in areas where these apparatuses are among the world's best. The UARI's situation is very good now because by the end of 1978 the world's largest impulse reactor (the IBR-2) will be operating at full capacity. We will also place the U-400 cyclotron in operation this year which is also among the best in its class. The IBR-2 will give unique research opportunities to the nuclear physics researchers. They can only be used, however, if the appropriate measuring instruments are also available at the same time. It is here where a large job awaits the researchers and the Hungarian institutions that are interested parties in the cooperation at Dubna.

This thought is continued by Gyorgy Vesztergombi who is an old-timer at Dubna and whose publications and research achievements place him among the leaders of the young scientists.

"We try to add a small but an identifiable part to high-energy physics research. We contribute intellectually especially; a quick evaluation of the measurements improves the effectiveness of the accelerator," he says.

Dubna also provides an opportunity for our scientists to be in permanent contact with the world leaders. There is no satisfactory accelerator for the high-energy research and even the Serpuhov accelerator which was the world's best at the end of the sixties is obsolete but the UARI maintains good contact with the great Western research institutes: the Western European CERN, the American Batavia. They are carrying out collaborative measurements and are preparing for the construction of the new, giant accelerator at Serpuhov which will be among the leaders in the scientific world again.

It is good to learn that noted Hungarian achievements occurred in several research areas. Lectures given at international conferences, academic and institute prizes, and candidate and doctoral dissertations indicate the successes.

"We carry out basic research mostly at Dubna," Dezso Kiss explains. "Without this, there is no scientific progress. As pointed out by the XXV. Congress report, without this the flow of scientific and technical revolution would come to a halt. However, applied research has been increasingly carried out by the institute's experts, among them the Hungarians, in recent years."

These include the use of neutrons in technical and biological research. They assess diagnostic and therapeutical possibilities. At the synchrocyclotron our scientists showed the large metal cabin in which they examine the bone

tissues and bone calcium content of people and patients who are immobile for long periods. Another laboratory produced the production technology of microfilters that clean air and water and even preserve wine because it filters out even the microbes.

"Dubna is not an ivory tower of science. It has as the first, largest mutual research institute of the socialist community, an immeasureable political importance. The collaboration visible here, the successful cooperation is an example that can be followed," adds Dezso Kiss, academician.

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CSO: 2502

HUNGARY

MINICOMPUTERS FOR CONTROL OF MACHINE TOOLS

Budapest SZAMITASTECHNIKA in Hungarian Mar 78 p 4

[Unattributed article: "SZIM [Machine-Tool Factory] Manufactures Machine Tools controlled by Minicomputer"]

[Text] The series manufacture of numerically controlled machine tools with minicomputer control begins this year at the SZIM. The production plan of SZIM, in the amount of 2 billion forints, covers 70 percent machine tools, of which 85 percent goes for export (half of the export to capitalist markets).

In this major Hungarian machine-tool factory, modernization of the products is the goal since several years; it now implements reconstruction measures and the introduction of new technologies, partly from its own resources and partly from bank credits. As a first result of these measures, a new assembly line was started for the manufacture of high-accuracy numerical control systems (in the value of 450 million forints this year, compared to 250 million last year). Thirty percent of the entire machine-tool manufacturing volume of the enterprise is now numerically controlled. The production program is recorded on punched tape or magnetic tape, so that the machine operator only has to clamp in the workpiece. Then, the machine will automatically execute the full technological program. The productivity of a numerically controlled machine tool is three to four times as high as that of a conventional machine tool. The latest version of the numerically controlled machine tool is the machine tool controlled by a minicomputer (CNC). Such a system was exhibited by SZIM at last year's Hannover world machine tool fair, where only two or three other manufactures showed such equipment. Ninety CNC lathes will be manufactured this year; some will be used domestically but most will be exported. According to surveys, enterprises from even the largest capitalist countries are interested in these machine tools.

2542
CSO: 2502

FACTORY MAKES DATA TRANSFER INSTRUMENTS

Budapest SZAMITASTECHNIKA in Hungarian Mar 78 p 3

[Article by Andras Grotte and Lajos Nobik: "Metrology in Data Teleprocessing; Data-Transmission Equipment Manufactured by Orion"]

[Text] The development of computer technology moves toward divided processing, in addition to the development of large processors. This trend is helped by the increasingly intelligent design of the hardware devices. This is a contribution of a modern component base resulting from technological advancement, which provided considerable assistance to the designer. As a result of divided processing and the availability of intelligent hardware devices, the computation capacity earlier concentrated in the computer centers leaves its isolation and becomes an everyday tool of the working man. Here we mean applications such as management information systems, warehousing (stores and inventories), and so forth.

All these systems form part of a data teleprocessing system so that their operation is based on the data-transmission network which makes the operation of the entire operation possible with the connections and terminals.

In the organization of the data traffic between the data stations (terminals) and the central processor (host) computer, both the topology of the network and the transmission system are of decisive importance.

It can be seen from the foregoing that the layout and operating complexity of the jointly operated devices imposes very strict requirements on the management of the network. The data transmission instruments designed for special measuring tasks play an important role here.

Recognizing this, Orion developed and started the manufacture of the AP-TEST terminal checking simulator and the DATEST-2 data-transmission checking station (see the article in SZAMITASTECHNIKA, December 1977 issue, p 1).

As we have mentioned earlier, the terminal systems developed from the integration of communication and computer technology. This factor means that they need special measuring instruments to solve the special problems involved.

Disregarding the computer itself, we expect the following needs: checking the operation of the terminal, checking the modems, checking the channel, checking the channel and the modem together, and checking the complex system consisting of the modems, the channel, and the terminal. These measuring tasks emerge at various times. We distinguish betweem a pre-installation period, an installation period, and a continuous-operation period in the "life" of a terminal system. The measuring problems arise in various combinations during the various life stages, and the individual measurements must be weighted differently during the various stages.

Before installation:

- -Checking the lines (for example, measuring the error ratio);
- -Checking the individual terminals (for example, address setting).

During installation:

- -Joint checking of modem-line-modem (for example, measuring the error ratio);
- -Checking the modem-line-modem-terminal system (for example, the algorithm, security of the connection, address recognition).

During operation:

- -Periodic checking of the line quality (error ratio);
- -Localization of any faults;
- -Servicing.

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CSO: 2502

VIDEOTON COMPUTER EQUIPMENT IN BULGARIA

Budapest SZAMITASTECHNIKA in Hungarian Mar 78 p 4

[Text] VIDEOTON installed late last year two new, highly configured R-10 systems in Bulgaria. The equipment performs highly reliable real-time data acquisition and process control in electric power distribution systems. Its use, configuration, and user software are similar to that of VIDEOTON equipment already operating in the USSR and Czechoslovakia. An R-10 system for experimental plant-organization and measured-data acquisition was installed in a non-ferrous metal factory in Sofia during January of this year.

In Bulgaria there is considerable interest in the VTS 56 100 terminal family: experts from VIDEOTON will install more than 30 terminals during the first quarter of this year in various areas of the Bulgarian national economy: industrial computer centers, health facilities, chemical industry, and heavy-industry enterprises. The interest in the terminal family is heightened by the fact that the AP-62 version, of which the line algorithms was developed by an international team including Bulgarian experts, can be very well used in the ESTEL data teleprocessing system. Series manufacture of ESTEL equipment will start this year.

2542
CSO: 2502

STATUS, PROBLEMS OF VIRUS RESEARCH REPORTED

Budapest AKADEMIAI KOZLONY in Hungarian 13 Apr 78 pp 52-54

[Report about the status and problems of virus research in Hungary]

[Text] The Presidium of the Hungarian Academy of Sciences (MTA) formed an ad hoc committee with its Resolution 4/1977 with the task of examining the status and problems of domestic virus research. In addition to exploring the current situation, the committee was also asked to develop a concept for this research during the forthcoming period which ensures that the fight against viruses will be more effective than it is today 10-12 years hence under the conditions which will prevail at that time.

The members of the committee are virologists active in the field of plant, animal, and human health, scientific researchers from other relevant disciplines, and state administration experts.

The committee has evaluated the equipment, supply situation, and research plans of all research institutions in the country where virus research is carried out. The leaders of these institutions, in cooperation with their staffs, developed proposals for increasing the efficiency of domestic virological research. The committee has also solicited expert tesimonies from 50 researchers. The data acquired in this manner were evaluated, and the committee has formulated a draft proposal. The proposal was debated at the 30 November 1977 academic conference. The report of the committee was finalized on the basis of the draft and the comments made at the conference.

The conference, considering the comments made, as well as the written comments obtained from the state secretary of the Ministry of Health, the state secretary of the Ministry of Agriculture and Food, and the deputy chairman of the OMFB [State Technical Development Committee], basically agreed with the recommendations of the report. Most comments dealt with additions and clarifications, which were incorporated in the final version.

Resolution 7/1978 of the Presidium

1. The Presidium expresses its thanks to the chairman, secretaries, and members of the committee for their high-quality report, and thanks to all researchers who contributed to the report through their expertise.

2. The Presidium approves the major recommendations of the report as outlined below.

2.1. The coordination, the concentration of material and intellectual resources, and the cooperation must be improved significantly in all areas of virus research.

In order to accompoish this, the MTA [Hungarian Academy of Sciences], the MEM [Ministry of Agriculture and Food], and the EuM [Ministry of Health] should jointly ask the appropriate specialist institutions that they debate the possibilities and conditions of the appropriate coordination and cooperation during the 1978-1979 period, so that their recommendations could be implemented in the formulation of the research plans for the 1981-1985 period.

2.2. To allow more effective fight against the viruses, there is a need for improvements in the diagnostic methods in all areas. Among the scientific research projects, efforts aimed at adapting, improving, and spreading of such methods must be emphasized.

2.3. The university teaching of virology must be expanded, and the virological researchers should be utilized in the educational system. Interest in virology must be awakened in scientific student circles. There should be more special virological colloquia in agricultural, medical, and scientific universities. Increased support should be given to virological research activities operating in university centers for the expansion of the work of scientific student circles and special colloquia.

Domestic and foreign study trips should be allowed for experts engaged in studies of plant, animal, and human virology so that they become increasingly proficient in their specialty. In the field of human virology, widespread training should be given to practising physicians to improve the virus diagnostic situation. A framework for training domestic virological assistants should be set up.

2.4. A prime prerequisite for development of virology is a qualitative and quantitative improvement in the domestic supply of experimental animals and locally made starting materials.

- The industrial-scale manufacture of the needed types of nutrient media by the Human Vaccine Manufacturing and Research Enterprise must be set up.

- Calf and cattle serum of the needed quality and in the required amounts must be ensured at Phylaxia Vaccine and Nutrient Works, and the quality of the products made there must be improved.

- The facilities of the Laboratory Stock Animal Breeding Institute must be expanded to permit this institution to supply experimental animals for research. The quick availability of special experimental animals, which are infrequently needed (such as primates and naked mice), must be ensured.

- The procurement of chemicals and base materials must be considerably speeded up. A central virological supply storage facility must be set up. It must hold supplies needed for virological research.

2.5. To bring virus research to the desired level, constructions will also be needed during the next 5-7 years.

- The greenhouse area must be expanded for plant-virological studies in the appropriate research institutions of the MEM, in accordance with the virus-fighting program approved earlier.

- The Department of Virology, presently operating at the Research Institute of Veterinary Medical Sciences of the MTA, should be strengthened in conjunction with its transfer to Debrecen so that it becomes capable of performing much of the basic research needed in conjunction with the animal health problems involving the production of foods of animal origin.

- The plans for the new virological building of the National Institute of Public Health have been completed. The edifice will have a floor area of approximately 25,000 square meters, and it should be constructed during the first half of the Sixth Five-Year Plan period.

This center should be able to supply all human-virological laboratories in the country with reference material and diagnostic means (virus strains, reference sera, antigens, cell lines, cell clones, and so forth). It should also have the prerequisites for producing and studying vaccines and inoculants.

- The human virus diagnostic network of the country must be significantly expanded by establishment of new laboratories, at least in three KOJAL's [expansion unknown], taking the coverage situation into consideration.

2.6. By improving the potentialities of medical basic and applied virology atudies through the much needed staff development and through the provision of equipment, it will be ensured that the results of research are properly implemented in practice. With this goal in mind, properly chosen themes must be more thoroughly investigated on a broadened basis at the Microbiological Research Group of the MTA and the Departments of Virus Research and Vaccine-Analysis of the OKI [National Institute of Public Health].

2.7. In developing the plant-virological studies, use must be made of the latest plant-physiological, plant-genetical, and plant-biochemical research results and methods.

- Tissue culture, tip meristema growing;
- Heat-therapeutic virus killing;
- Immunization with weakened virus strains;
- Selection and mutation in single-cell cultures;
- Hybridization by means of protoplast fusion;
- Resistance improvement, primarily by means of species hybridization.

Adequate support for these themes must be made available, including staff development, within the plans of the Szeged Biological Center of the MTA and the appropriate research institutions of the MEM.

2.8. In the field of applied animal-health studies, the facilities of the institutions of animal health, of the virus-producing sections of Phylaxia, and the Institute of Testing Veterinary Vaccines must be expanded. This will create the basic prerequisites for modern diagnostic and vaccine-producing development. In these large institutions it is necessary to institute studies dealing with the virus-infection combating in large-scale animal breeding establishments. In order to provide for specialized advanced training in virology, a section with at least five virologists should be set up within the University of Veterinary-Medical Sciences.

2.9. In order to reduce the damage caused by animal diseases of viral origin and to improve materially the quality of the vaccine production, we need to produce more effective, more highly concentrated, and better purified virus vaccines. We must make sure as soon as possible that the live-virus vaccines are made with SPF-quality base materials (eggs, primary tissues, and sera), so that the spreading of disease-causing agents through these vaccines comes to a stop.

2.10. Consideration should be given to the establishment of a general virological research institution to meet the expected long-range need for virus research. The tasks of this institution would include basic studies aimed at more effective measures against plant, animal, and human viruses, as well as the systematic advanced training of experts engaged in the field of applied virology. The research goals of the institution must be coordinated with the tasks of the other virological research establishments in the country.

It is advisable to establish such a central institution through the expansion of an already existing relevant research institution. Taking our financial resources into consideration, and considering our staff shortage, it seems that this institution cannot be established before the late 1980's. This proposal must be examined, and a decision reached, when the Sixth Five-Year Plan is discussed.

3. The Presidium deems it desirable to give more publicity in the press to matters concerning the status and problems of virus research.

2542
CSO: 2502

ROMANIA

RELATIONSHIP BETWEEN ECONOMIC GROWTH, ENERGY CONSUMPTION

Bucharest ENERGETICA in Romanian No 10, Oct 77 pp 387-390

/Article by Florin Alexe, assistant at the Bucharest Polytechnical Institute, Faculty of Power Engineering, Department of Electric Power Stations: "Interdependence of Economic Development and Energy Consumption"/

/Text/ The rapid increase of the world's population and the need of raising the living standard (or the desire to make greater profits in the capitalist economy) and of closing the gaps between the various countries are making rapid economic growth increasingly necessary, especially in the developing countries /1, 2/. This entails a greater per capita and total energy consumption, while the energy reserves are limited and increasingly expensive.

There is a close correlation between an economy's developmental level and its consumption of energy resources. For example, when we compare the shares of the various regions of the world in the gross world product (PMB) and in the total energy consumption (CE), and their per capita gross product (PNBL) with their per capita energy consumption (CEL), we find some close correlations among these indices (see Table 1 /3/).

There is an equally close interdependence between the economic growth rate and that of energy consumption (see Table 2 /2/).

If we convert the data in Tables 1 and 2 to graphs wherein the per capita gross national product is noted on an abscissa, we obtain Figures 1, 2 and 3. (1).

Figures 1 and 2 also include the points denoting the levels of the respective indices in Romania in 1972 ($935 per capita, 2,912 kg of cc /conventional fuel/ per capita, and 3,114 kg of cc per dollar) /1/, /4/.

Figure 2 shows the linear function and Figures 1 and 3 the parabolic functions approximating the best ratio between the indices on ordinates and the PNBL on an abscissa. The method of the minimum average quadratic error was used to determine these functions, the proportion of each point being equal to the respective region's share in the PMB.

Table 1

Values of CEL, Gross National Product per Capita, and Specific Energy Consumption per Dollar of PNB, in Various Countries and Regions

	Regiunea 1)	Ponderea regiunii în % 2)		PNBL $/loc 3)	CEL kgcc/loc 4)	CEL/PNBL kg c.c/$ 5)
		PMB	CM			
6)	America de Nord	33,3	37,3	3437	9524	2,771
7)	Europa de Vest	26,1	20,4	1685	3256	1,932
8)	Țări socialiste Europa + URSS	19,1	22,9	1269	3778	2,977
9)	Asia (țări nesocialiste)	10,3	7	210	354	1,686
10)	America Latină	4,3	3,6	395	821	2,0785
11)	Asia (țări socialiste)	3,7	5,9	111	441	3,973
12)	Africa	1,9	1,7	139	298	2,144
13)	Oceania	1,3	1,1	1613	3563	2,209
14)	TOTAL MONDIAL	100,0	100,0	674	1668	2,4747

Table 2

Average Overall Economic Growth and Growth of CE in Various Regions in 1950-1972. (When the Growth Rate of CE was Unaffected by the Petroleum Price Rise)

	1) Regiunea	15) Rate medii de creștere (1950–1972), %		3) PNBL $/loc.	16) Rata de creștere a CE / Rata de creștere a PNB 17)
		CE	PNB		
6)	America de Nord	3,2	3,8	3437	0,84
7)	Europa de Vest	4,4	4,8	1685	0,92
8)	Țări socialiste Europa + URSS	6,9	5,6	1269	1,23
18)	Asia	9,0	6,8	147	1,32
10)	America Latină	7,6	4,9	395	1,55
12)	Africa	5,4	4,4	139	1,23
13)	Oceania	5,0	4,2	1613	1,19
14)	TOTAL MONDIAL	5,1	4,8	674	1,06

1. Region
2. Share of region, in %
3. PNBL in dollars per capita
4. CEL in kg of cc per capita
5. CEL over PNBL in kg of cc per $1
6. North America
7. Western Europe
8. European socialist countries, USSR
9. Asia (nonsocialist countries)
10. Latin America
11. Asia (socialist countries)
12. Africa
13. Oceania
14. World total
15. Average growth rates (1950-1972), %
16. Growth rate of CE
17. Growth rate of PNB
18. Asia

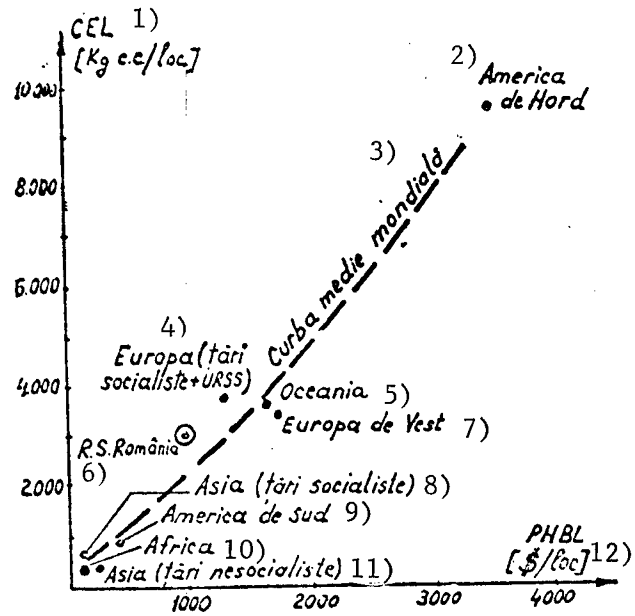

Figure 1. Variation of CE with PNBL in Various Regions of the World

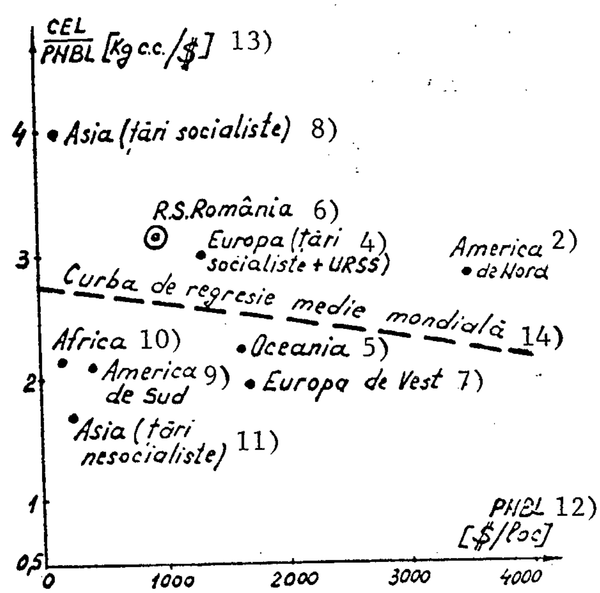

Figure 2. Variation of Specific CE per Dollar of GNP with PNBL

1. CEL in kg of cc per capita
2. North America
3. Average world curve
4. Europe (socialist countries, USSR)
5. Oceania
6. Romania
7. Western Europe
8. Asia (socialist countries)
9. South America
10. Africa
11. Asia (nonsocialist countries)
12. PNBL in dollars per capita
13. CEL over PNBL in kg of cc per $1
14. Average world curve of regression

We obtained the following equations:

$$\mathrm{CEL} = 253{,}25 + 1{,}632 \cdot \mathrm{PNBL} + \frac{\mathrm{PNBL}^2}{3264{,}7} \quad (1)$$

$$\left(\frac{\mathrm{CEL}}{\mathrm{PNBL}}\right) = 2{,}7328 - 0{,}000136 \cdot \mathrm{PNBL} \quad (2)$$

$$\frac{\text{Rata CE}}{\text{Rata PNB}} = 1{,}473 - \frac{\mathrm{PNBL}}{270} + \frac{\mathrm{PNBL}^2}{18650} \quad (3)$$

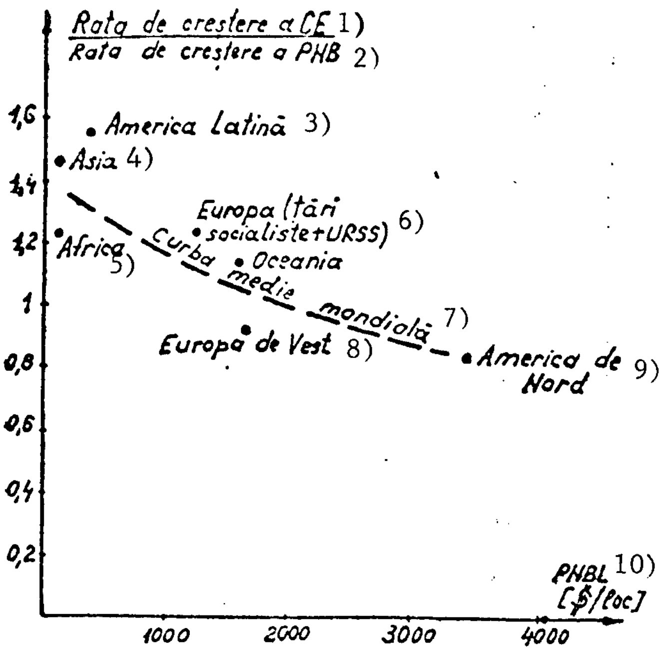

Figure 3. Ratio Between the Growth Rate of Energy Consumption and the Overall Economic Growth Rate, in Various Areas of the World

1. Growth rate of CE
2. Growth rate of PNB
3. Latin America
4. Asia
5. Africa
6. Europe (socialist Countries and USSR)
7. World average curve
8. Western Europe
9. North America
10. PNBL (dollars per capita)

These graphs brought out the extent and nature of the dependence of the CEL upon the level of economic development and enabled us to draw some helpful conclusions for purposes of "relaxing" this dependence and obtaining the fastest possible growth rate with the slowest possible CE.

Figures 1 and 2 indicate that a number of countries including Romania are far above the line of regression. This is a disadvantage, especially in the countries importing fuel and energy. Comparison of the Romanian indices with the

world ones indicates the necessity of making energy consumption more effective by reduction of specific inputs, improvement of technologies, and rational management of fuels and energy.

As for the variation of the ratios between the CE and PNB growth rates, and of the CE per dollar produced (Tables 1 and 2, Figures 2 and 3), note that the developing and intermediately developed countries show a ratio above 1 (reaching higher values especially in regions with high rates of economic growth) and a CE per dollar produced above the world average, but as their national economies develop the specific CE per dollar produced and the ratio of the growth rates decline, making the CE more effective (2, 3).

In the particular case of Romania (where the CE growth rate in 1950-1972 was about 1.2 times higher than that of the world economy, reaching a specific CE of 3,114 kg of cc per dollar, or 1.26 times greater than the world average), efficient measures were adopted to make rational use of fuels and energy: In 1972-1925 for example the CE growth rate dropped practically to that of economic growth. Nevertheless these measures are not sufficient in the long run.

If Romania is to reach a point on the line of regression in Figure 2 by the end of the 1975-1990 period (when a rapid growth rate of the PNBL of about 8 per cent will be maintained), the actual value (4) of the PNBL will have to be some $3,700 and the average CE will have to be about 9,800 kg of cc per capita, or 2,223 kg of cc per dollar. For this purpose the average CEL growth rate will have to be 5.8 percent and the ratio between the two rates 0.725, namely below 1 and even lower than the value in North America (see Table 2) (5). Of course a sharp reduction of the CEL growth rate could interfere with the overall economic growth rate and the rise of the people's living standard, so that the CE growth rate should gradually drop to about 6.3 percent in 1976-1980, 5.9 percent in 1981-1985, and 5.5 percent in 1986-1990. In this way Romania can attain a high value of the PNBL and a highly effective use of fuels and energy in 1990.

These objectives can be accomplished in the socialist Romania of 1990 through continued application of some well-advised measures like those provided in the recent party and state documents (6):

- Use of new technologies to reduce specific energy inputs in industry;

- Expansion of combined production of electric power and heat in thermal electric power stations and centralized delivery of heat;

- Recovery of the energy losses in industry in general and in the chemical, metallurgical and by-product coke industries in particular;

- Direction of the economic growth effort toward industries (or technologies) with low specific CE and high productivity (the electronics industry, automation elements etc.);

- Reduction (or elimination) of exportation of products the costs of which include heavy inputs of energy and raw material and little skilled labor (aluminum ingots, raw steel rolled products etc.);

- Concentration of manufacture of small and medium components and subassemblies requiring high CE (small and medium cast parts for example) in big units, permitting high productivity and recovery of residual energy.

To be sure this article has its imperfections (inherent in any long-range forecasting), but its conclusions can be improved in the course of the period under consideration by careful analysis of national and worldwide economic evolution.

The main purpose of the article is not to determine fixed policies to be followed (for there is certainly a multitude of economic and energy policies that can lead to the results anticipated here), but to bring out the importance that must be attached henceforth to the conservation of fuel and energy and to warn against further increase in Romania's CE at the same rate as the world's economic growth.

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FOOTNOTES

1. The figures in Tables 1 and 2, converted to graphs in Figures 1, 2 and 3, refer to the period before the energy crisis (Table 1 refers to 1972 and Table 2 to 1950-1972). The more recent figures are incomplete and contradictory and some are questioned in various statistical yearbooks. Moreover the energy crisis caused great discontinuities in the evolution of the of the CEL and PNBL as well as the economic recession in a number of developed capitalist countries, so that the more recent figures are liable to be insignificant. It would be useful to update these statistics after an economic and energy stabilization, which is being delayed in the western countries with a large share in the PMB and CE.

2. One of the main reasons why the developing countries show high specific CE per unit of PNB as well as growth rate ratios above 1 (CE rate per PNB rate) is their lack of peak modern technologies with low CE and the industrially advanced nations' reluctance to transfer technology to them.

   Note that a large part of the developed countries' PNB's come from services and economic sectors with low CE such as finance and banking, trade, tourism, export of capital and know-how, etc. while most of the developing

countries are concentrating their industrialization on the chemical and heavy industries, which are both large consumers of energy.

Another, more important reason of the developing countries that have chosen a noncapitalist development is the need of rapid improvement in their living standards.

3. The figures on CE and its growth rate refer to consumption of primary energy. The world consumption of electric power has a higher growth rate, tending to increase the proportion of electric power in the world's energy reserve. This process is more intensive in the developed countries, where the consumption of primary energy to produce electric power amounts to 25-30 percent of the total consumption.

4. The per capita value of the PNBL of about $3,700 in the socialist Romania of 1990 is based upon the assumption of an annual growth rate of the PNBL of 8 percent and upon the provisions of the RCP Program, which estimates a per capita national income of about $3,500-$4,000 in 1990.

5. In the light of Footnote 3, the growth rate of the per capita electric power consumption in this period must be kept as close as possible to the growth rate of the PNBL, so that the difference between the two growth rates will meet the requirement for a higher proportion of electric power in Romania's energy reserve. So far from wasting primary energy, this energy policy will permit major savings and better use of our domestic resources of inferior fuel, thanks to the great productivity of transmission and use of electric power.

6. See also the recent decree on energy conservation.

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END

JPRS 71173

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JPRS 71173

24 May 1978

TRANSLATIONS ON EASTERN EUROPE

SCIENTIFIC AFFAIRS

No. 584

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BULGARIA

PROGRESS IN LASER TECHNOLOGY DEVELOPMENT

Sofia OTECHESTVEN FRONT in Bulgarian 10 Mar 78 pp 1, 3

[Article by Zakhari Nikolov: "This Miracle, the Laser, Is Extensively Entering our Lives"]

[Text] The discovery of lasers and their comprehensive utilization are among the greatest accomplishments of physics in the second half of the 20th Century. The radical changes in the development of our science under the people's system legitimately led to successes in the field of laser technology in Bulgaria.

This was the reason for our visit to the specialized quantum electronics laboratory of the physics department of Kliment Okhriski Sofia University. Many of the scientific workers are students of the now deceased Soviet scientist academician Rem Viktorovich Khokhlov, Moscow University Rector and deputy chairman of the USSR Academy of Sciences. Docent Konstantin Stamenov, head of the quantum electronics laboratory remembers him with warmth and gratitude. Over 10 years ago he and, later, other Bulgarian physicists working in this field, were assigned to specialize at Moscow University. Here close contacts with the great Soviet scientist were the initial steps in our laser technology.

"It seemed to us that it may have been too early to begin studies in the field of lasers," said Docent Stamenov. "We had almost no material facilities or adequate experience. However, academician Khokhlov gave us the confidence that we could and should do everything possible for the development of Bulgarian laser technology."

This was followed by initial attempts with successes and failures. Today, however, the positive results are already obvious. The laboratory has mastered methods for transforming the wavelength of the laser light impulse from the infrared radiation zone to the range of ultraviolet rays. Lasers are being used providing very short light pulses. Why is this needed? The practical application of lasers requires, above all, knowledge of what could be obtained with their help and how.

The power of light radiation contained in the laser beam is tremendous. It has been established that a single laser beam could carry up to one million television programs. Naturally, in order to achieve this we must master the method for coding and decoding the information carried by the beam. Along with achieving super short radiation, the laboratory has developed holographic equipment for three dimensional photographs. Holograph equipment makes possible to see the studied matter, object, or process in its actual three dimensional sizes. In other words, in the immediate future the physicians will be able to conduct their observations on the human body with something resembling an x-ray photograph but three dimensional. Holography can also be used to control extremely small movements of bodies, and minor deformations in machine and engine vibrations (under 1,000th of a millimeter). It can be successfully used for the detection of images in criminal studies, the comparison of details, and so on. In the future it will be applied as a method for computer data processing.

"The possibilities of laser beams are exceptionally great," said Docent Tomov, another alumni of the laboratory headed by academician R. V. Khokhlov and Professor Dr. S. A. Akhmanov. "The exceptionally precise focusing of the beam and the control of its intensity make possible a number of fine operations which are impossible any other way. For example, a laser beam enables us to weld metal of different qualities and great melting temperature disparities."

In another laboratory we were shown metal-ceramic plates with almost invisible apertures. Few people know that it is precisely through such apertures that fine capron and polyamide fibers are spun for fine fabrics used in the textile industry. The Textiles and Textile Fibers Department of the Higher Chemical and Technological Institute in Sofia has been successfully experimenting with this new development. It will be applied in the plans which will use Bulgarian ceramic plates instead of imported expensive and undurable platinum ones. Laser beams will eliminate some minor defects in integrated circuits. Fine films used in microelectronics can be processed with lasers. Laser beams clean the tips of special imported needles for welding the leads of integrated circuits at semi-conductors plant in Botevgrad. A technology for fine tuning of quartz resonators has been developed used, for example, in the new Bulgarian time pieces. This also could be accomplished with a laser beam. Another interesting application of the laser beam is the possibility for surface spot heat welding of undurable cutting metal parts. This avoids the overall tempering of such parts, thus eliminating the danger of making them brittle. Methods and equipment are being developed for fast and remote control study of the composition and pollution of large water basins such as rivers, lakes, seas, and industrial water--with the help of lasers.

The use of lasers in medicine and, particularly, in surgery is very promising. A laser beam could be used as a scalpel for fine tissue cuts without affecting blood vessels, such as, in eye operations, in putting back a separated retina, in brain operations, and so on. A laser could even separate an individual cell.

Such is the comprehensive and very practical application of lasers in laboratories. It is quite clear that the possibilities offered by laser technology in our country and throughout the world are tremendous and that lasers will be used ever more extensively in all fields of science and human life.

5003
CSO: 2202

BULGARIA

UDC 621.382.2

SPECIFICATIONS OF BULGARIAN SILICON PULSE DIODES

Sofia RADIO, TELEVIZIYA, ELEKTRONIKA in Bulgarian No 1, 1978 p 32 and both sides of back cover

[Article by Engineer T. Moskov and Engineer G. Kondarev: "Silicon Pulse Diodes"]

[Text] Designed for use in computer technology, radioelectronics and industrial electronics. Produced at the semiconductor plant in Botevgrad.

2D5605, 2D5606.

Case: S64.

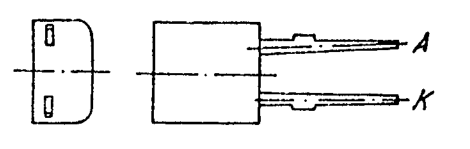

Figure 1.

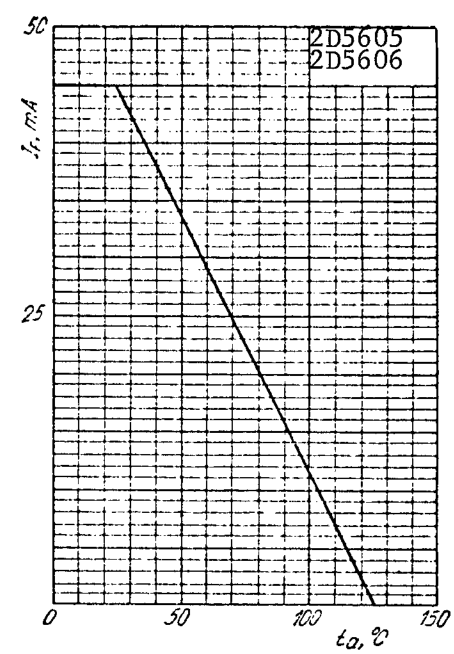

Figure 2. Direct forward current as a function of ambient temperature.

Table 1

Maximum Permissible Parameters

		2D5605	2D5606	
(1) Постоянно обратно напрежение	U_{Rmax}	20	40	
(2) Импулсно обратно напрежение	U_{RRMmax}	22	43	
(3) Постоянен ток в права посока	I_{Fmax}	45	45	mA
(4) Среден изправен ток	I_{omax}	45	45	mA
(5) Импулсен ток в права посока	I_{FRMmax}	250	250	mA
(6) Температура на прехода	t_{jmax}	125		°C
(7) Температура на съхранение	t_{stg}	—35 to +125		°C

Key:

1. Constant inverse voltage
2. Pulse inverse voltage
3. Direct forward current
4. Mean rectified current
5. Pulse forward current
6. Junction temperature
7. Storage temperature

Table 2

Principal Parameters at $t_a = 25^\circ$ C

			2D5605	2D5606	
Постоянно напрежение в права посока (1) $I_F = 10$ mA	U_F	max	1	1	V
Постоянен обратен ток (2) $U_R = 20$ V	I_R	max	1		µA
$U_R = 40$ V		max		1	µA
Капацитет на диода (3) $U_R = 0$, $f = 1$MHz	C_{tot}	max	4	4	pF
Време за възстановяване на обратното съпротивление (4) $I_F = 10$ mA, U_R 6 V i_{rr} 0,1 I_F, R_2 100 Ω	t_{rr}	max	5	5	ns
Импулсно напрежение в права посока (5) I_F 100 mA, $t_u = 300$ µs	U_{FSM}	max	1,5	1,5	V

[Key on next page]

Key to Table 2:

1. Constant forward voltage
2. Direct inverse current
3. Diode capacitance
4. Reverse recovery time
5. Pulse forward voltage

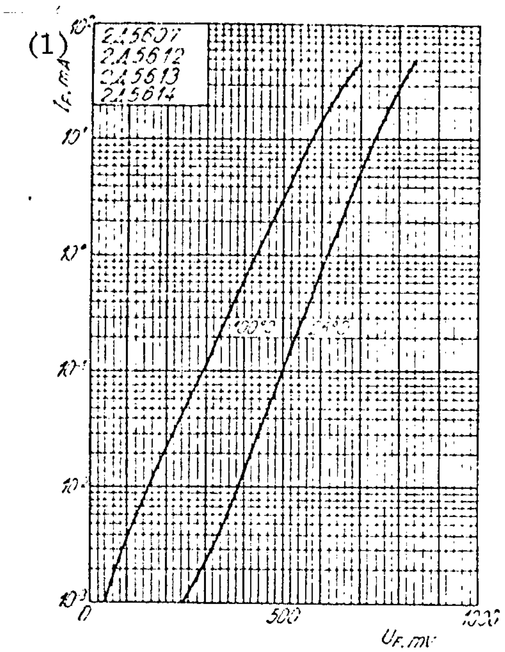

Figure 3. Constant forward voltage as a function of direct forward current.

Key:

1. 2D5607, 2D5612, 2D5613, 2D5614

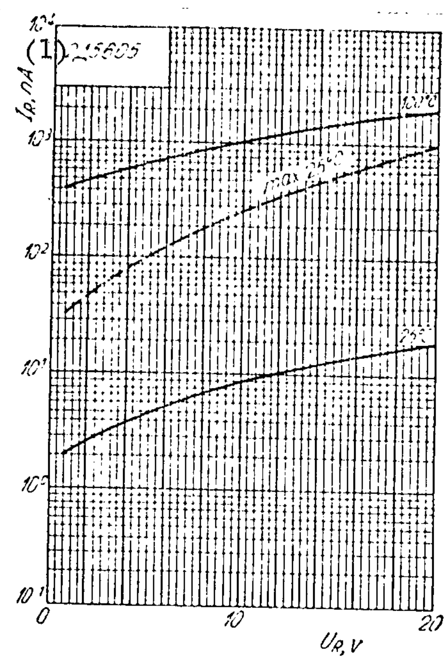

Figure 4. Direct inverse current as a function of constant inverse voltage.

Key:

1. 2D5605

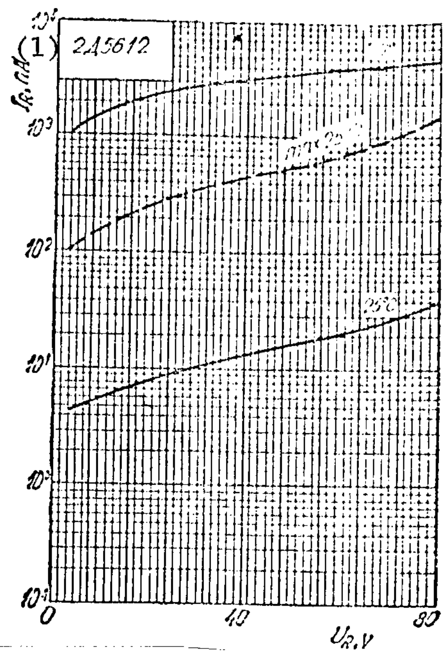

Figure 5. Direct inverse current as a function of constant inverse voltage.

Key:

1. 2D5612

Table 3

Maximum Permissible Parameters

		2D5607	2D5612	2D5613	2D5614	
Постоянно обратно напрежение (1)	U_{Rmax}	60	80	100	110	V
Импулсно обратно напрежение (2)	U_{RRMmax}	70	35	105	115	V
Постоянен ток в права посока (3)	I_{Fmax}	50	50	50	50	mA
Среден изправен ток (4)		50	50	50	50	mA
Импулсен ток в права посока (5)		250	250	250	250	mA
Температура на прехода (6)		125				°C
Температура на съхранение (7)		—55 to +125				°C

Key:

1. Constant inverse voltage
2. Pulse inverse voltage
3. Direct forward current
4. Mean rectified current
5. Pulse forward current
6. Junction temperature
7. Storage temperature

Table 4

Principal Parameters At $t_a = 25^{\circ}$ C

			2D5607	2D5612	2D5613	2D5614	
Постоянно напрежение в права посока (1) $I_F = 10$ mA	U_F	max	1	1	1	1	V
Постоянен обратен ток (2) $U_R = 60$ V	I_R	max	1				μA
$U_R = 70$ V		max		1	1	1	μA
Капацитет на диода (3) $U_R = 0$, $f = 1$MHz	C_{tot}	max	4	4	4	4	pF
Време за възстанозяване на обратното съпротивление (4)	t_{rr}						
$I_F = 10$ mA, $U_R = 6$ V							
$i_{rr} = 0,1\ I_F$, $R_2 = 100\ \Omega$		max	5	5	5	5	ns
Импулсно напрежение в права посока (5) $I_F = 100$ mA, $t_u = 300$ μs	U_{FSM}	max	1,5	1,5	1,5	1,5	V

Key:

1. Constant forward voltage
2. Direct inverse current
3. Diode capacitance
4. Reverse recovery time
5. Pulse forward voltage

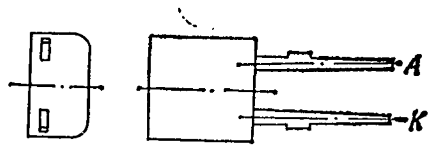

Figure 6.

2D5607, 2D5612, 2D5613, 2D5614.

Case: S64

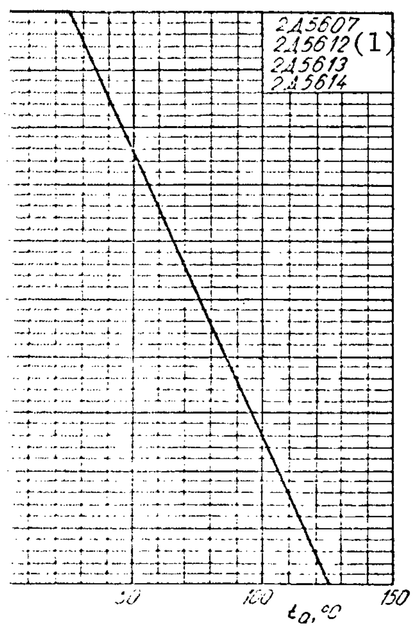

Figure 7. Direct forward current as a function of ambient temperature.

Key: 1. 2D5607, 2D5612, 2D5613, 2D5614

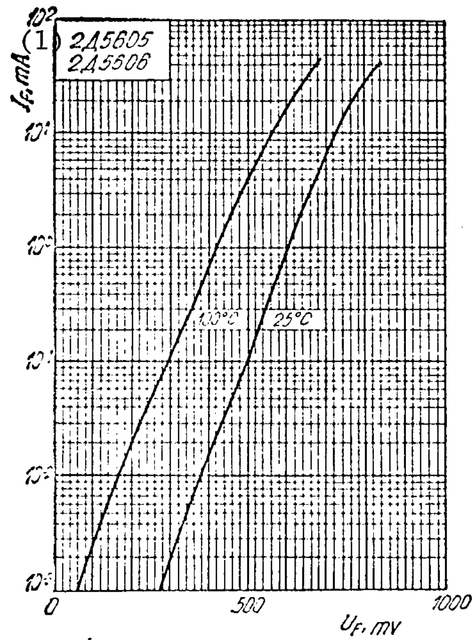

Figure 8. Constant forward current as a function of direct forward voltage.

Key: 1. 2D5605, 2D5608.

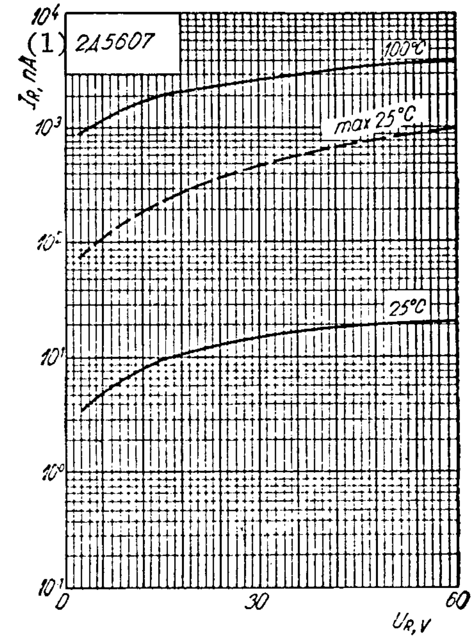

Figure 9. Direct inverse current as a function of constant inverse voltage.

Key: 2D5607

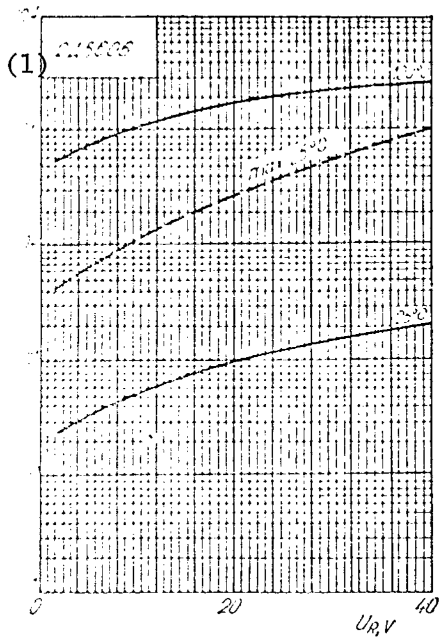

Figure 10. Direct inverse current as a function of constant inverse voltage.

Key: 1. 2D5606

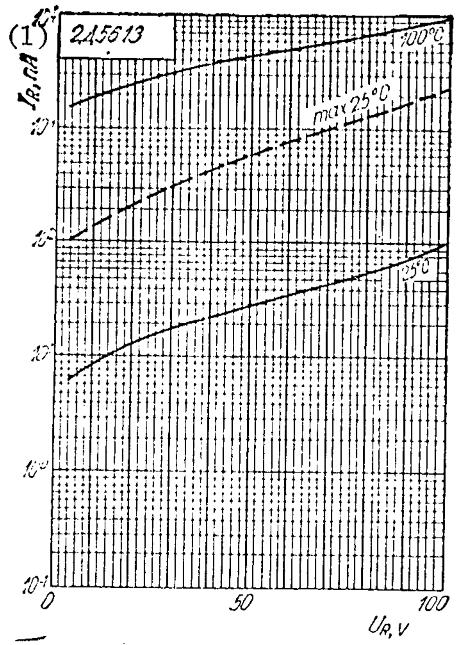

Figure 11. Direct inverse current as a function of constant inverse voltage.

Key: 1. 2 D5613

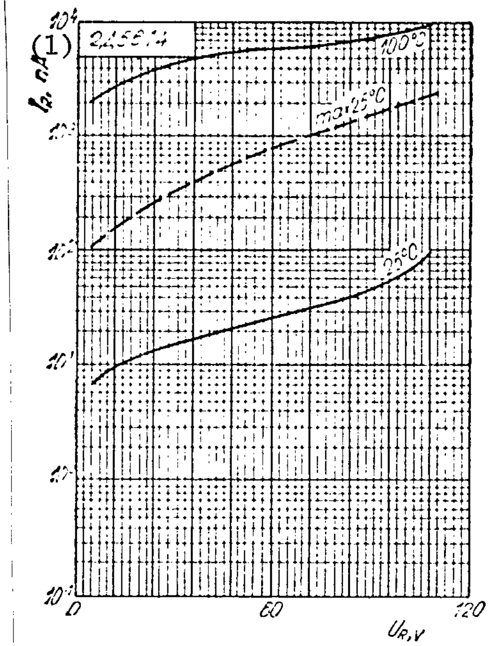

Figure 12. Direct inverse current as a function of constant inverse voltage

Key: 1. 2D5614

6474
CSO: 2202

SCIENTISTS, INSTRUMENTS AT DUBNA NUCLEAR RESEARCH INSTITUTE DESCRIBED

Budapest NEPSZABADSAG in Hungarian 14 Apr 78 p 4

[Article by Gyula Kekesdi dated "Dubna, April 1978"]

[Text] My guide in the synchrocyclotron building (which houses the oldest particle accelerator in the United Atomic Research Institute (UARI) at Dubna) is a tall, young, sympathetic Hungarian scientist. He explains that the accelerators, these complex installations, are the bases of research. The effects of the particle beams, emerging from several channels, answer the scientists' questions. He praises the monstrous machine which was once the world's largest accelerator.

In the early fall of 1956 I heard the late Veksler academician, one of the great personalities of the recently opened UARI at Dubna, say that Dubna was created so that the scientists of the socialist countries could participate in atomic physics research which has such a large role in science. Presently, 74 percent of the costs are borne by the USSR and 26 percent by the other partner countries. Hungary's share is 2.6 percent.

The institute on the bank of the Volga, 130 km. from Moscow, grew into a town by now. There are scientists from 11 countries here and 48 of them are Hungarian. The director of the UARI is N.N. Bogolyubov, Soviet academician. The two deputy directorships rotate among the other countries. One of them is presently a Hungarian, Dezso Kiss academician who directs the high-energy research and international contacts.

"There are 6000 employees here, of whom 800 are researchers" says the deputy director. The work is done in six scientific laboratories and one department. By size, these are essentially equivalent to an independent research institute. At least one of the deputy directors of the laboratories comes from the partner countries; presently Laszlo Cser and Janos Ero, in the neutron physics and nuclear laboratories, respectively, represent Hungary. Our compatriots filled responsible positions in the past also; e.g. Norbert Kroo and Zoltan Zamori were excellent deputy directors.

The majority of our delegates work in Hungarian groups which adds to the effectiveness. Such groups operate in the neutron physics, nuclear, and

high-energy laboratories. Hungarian participation is also significant in the theoretical physics laboratory and a few of our scientists work alone on their subjects.

Gyorgy Szentes, the leader of the Hungarian delegation tells me that Dubna engages in particle physics, nuclear physics, and neutron physics research. All these need an expensive, large apparatus, an accelerator or a reactor. The conditions for research are best in areas where these apparatuses are among the world's best. The UARI's situation is very good now because by the end of 1978 the world's largest impulse reactor (the IBR-2) will be operating at full capacity. We will also place the U-400 cyclotron in operation this year which is also among the best in its class. The IBR-2 will give unique research opportunities to the nuclear physics researchers. They can only be used, however, if the appropriate measuring instruments are also available at the same time. It is here where a large job awaits the researchers and the Hungarian institutions that are interested parties in the cooperation at Dubna.

This thought is continued by Gyorgy Vesztergombi who is an old-timer at Dubna and whose publications and research achievements place him among the leaders of the young scientists.

"We try to add a small but an identifiable part to high-energy physics research. We contribute intellectually especially; a quick evaluation of the measurements improves the effectiveness of the accelerator," he says.

Dubna also provides an opportunity for our scientists to be in permanent contact with the world leaders. There is no satisfactory accelerator for the high-energy research and even the Serpuhov accelerator which was the world's best at the end of the sixties is obsolete but the UARI maintains good contact with the great Western research institutes: the Western European CERN, the American Batavia. They are carrying out collaborative measurements and are preparing for the construction of the new, giant accelerator at Serpuhov which will be among the leaders in the scientific world again.

It is good to learn that noted Hungarian achievements occurred in several research areas. Lectures given at international conferences, academic and institute prizes, and candidate and doctoral dissertations indicate the successes.

"We carry out basic research mostly at Dubna," Dezso Kiss explains. "Without this, there is no scientific progress. As pointed out by the XXV. Congress report, without this the flow of scientific and technical revolution would come to a halt. However, applied research has been increasingly carried out by the institute's experts, among them the Hungarians, in recent years."

These include the use of neutrons in technical and biological research. They assess diagnostic and therapeutical possibilities. At the synchrocyclotron our scientists showed the large metal cabin in which they examine the bone

tissues and bone calcium content of people and patients who are immobile for long periods. Another laboratory produced the production technology of microfilters that clean air and water and even preserve wine because it filters out even the microbes.

"Dubna is not an ivory tower of science. It has as the first, largest mutual research institute of the socialist community, an immeasureable political importance. The collaboration visible here, the successful cooperation is an example that can be followed," adds Dezso Kiss, academician.

10,101
CSO: 2502

MINICOMPUTERS FOR CONTROL OF MACHINE TOOLS

Budapest. SZAMITASTECHNIKA in Hungarian Mar 78 p 4

[Unattributed article: "SZIM [Machine-Tool Factory] Manufactures Machine Tools controlled by Minicomputer"]

[Text] The series manufacture of numerically controlled machine tools with minicomputer control begins this year at the SZIM. The production plan of SZIM, in the amount of 2 billion forints, covers 70 percent machine tools, of which 85 percent goes for export (half of the export to capitalist markets).

In this major Hungarian machine-tool factory, modernization of the products is the goal since several years; it now implements reconstruction measures and the introduction of new technologies, partly from its own resources and partly from bank credits. As a first result of these measures, a new assembly line was started for the manufacture of high-accuracy numerical control systems (in the value of 450 million forints this year, compared to 250 million last year). Thirty percent of the entire machine-tool manufacturing volume of the enterprise is now numerically controlled. The production program is recorded on punched tape or magnetic tape, so that the machine operator only has to clamp in the workpiece. Then, the machine will automatically execute the full technological program. The productivity of a numerically controlled machine tool is three to four times as high as that of a conventional machine tool. The latest version of the numerically controlled machine tool is the machine tool controlled by a minicomputer (CNC). Such a system was exhibited by SZIM at last year's Hannover world machine tool fair, where only two or three other manufactures showed such equipment. Ninety CNC lathes will be manufactured this year; some will be used domestically but most will be exported. According to surveys, enterprises from even the largest capitalist countries are interested in these machine tools.

2542
CSO: 2502

FACTORY MAKES DATA TRANSFER INSTRUMENTS

Budapest SZAMITASTECHNIKA in Hungarian Mar 78 p 3

[Article by Andras Grotte and Lajos Nobik: "Metrology in Data Teleprocessing; Data-Transmission Equipment Manufactured by Orion"]

[Text] The development of computer technology moves toward divided processing, in addition to the development of large processors. This trend is helped by the increasingly intelligent design of the hardware devices. This is a contribution of a modern component base resulting from technological advancement, which provided considerable assistance to the designer. As a result of divided processing and the availability of intelligent hardware devices, the computation capacity earlier concentrated in the computer centers leaves its isolation and becomes an everyday tool of the working man. Here we mean applications such as management information systems, warehousing (stores and inventories), and so forth.

All these systems form part of a data teleprocessing system so that their operation is based on the data-transmission network which makes the operation of the entire operation possible with the connections and terminals.

In the organization of the data traffic between the data stations (terminals) and the central processor (host) computer, both the topology of the network and the transmission system are of decisive importance.

It can be seen from the foregoing that the layout and operating complexity of the jointly operated devices imposes very strict requirements on the management of the network. The data transmission instruments designed for special measuring tasks play an important role here.

Recognizing this, Orion developed and started the manufacture of the AP-TEST terminal checking simulator and the DATEST-2 data-transmission checking station (see the article in SZAMITASTECHNIKA, December 1977 issue, p 1).

As we have mentioned earlier, the terminal systems developed from the integration of communication and computer technology. This factor means that they need special measuring instruments to solve the special problems involved.

Disregarding the computer itself, we expect the following needs: checking the operation of the terminal, checking the modems, checking the channel, checking the channel and the modem together, and checking the complex system consisting of the modems, the channel, and the terminal. These measuring tasks emerge at various times. We distinguish betweem a pre-installation period, an installation period, and a continuous-operation period in the "life" of a terminal system. The measuring problems arise in various combinations during the various life stages, and the individual measurements must be weighted differently during the various stages.

Before installation:

-Checking the lines (for example, measuring the error ratio);
-Checking the individual terminals (for example, address setting).

During installation:

-Joint checking of modem-line-modem (for example, measuring the error ratio);
-Checking the modem-line-modem-terminal system (for example, the algorithm, security of the connection, address recognition).

During operation:

-Periodic checking of the line quality (error ratio);
-Localization of any faults;
-Servicing.

2542
CSO: 2502

VIDEOTON COMPUTER EQUIPMENT IN BULGARIA

Budapest SZAMITASTECHNIKA in Hungarian Mar 78 p 4

[Text] VIDEOTON installed late last year two new, highly configured R-10 systems in Bulgaria. The equipment performs highly reliable real-time data acquisition and process control in electric power distribution systems. Its use, configuration, and user software are similar to that of VIDEOTON equipment already operating in the USSR and Czechoslovakia. An R-10 system for experimental plant-organization and measured-data acquisition was installed in a non-ferrous metal factory in Sofia during January of this year.

In Bulgaria there is considerable interest in the VTS 56 100 terminal family: experts from VIDEOTON will install more than 30 terminals during the first quarter of this year in various areas of the Bulgarian national economy: industrial computer centers, health facilities, chemical industry, and heavy-industry enterprises. The interest in the terminal family is heightened by the fact that the AP-62 version, of which the line algorithms was developed by an international team including Bulgarian experts, can be very well used in the ESTEL data teleprocessing system. Series manufacture of ESTEL equipment will start this year.

2542
CSO: 2502

STATUS, PROBLEMS OF VIRUS RESEARCH REPORTED

Budapest AKADEMIAI KOZLONY in Hungarian 13 Apr 78 pp 52-54

[Report about the status and problems of virus research in Hungary]

[Text] The Presidium of the Hungarian Academy of Sciences (MTA) formed an ad hoc committee with its Resolution 4/1977 with the task of examining the status and problems of domestic virus research. In addition to exploring the current situation, the committee was also asked to develop a concept for this research during the forthcoming period which ensures that the fight against viruses will be more effective than it is today 10-12 years hence under the conditions which will prevail at that time.

The members of the committee are virologists active in the field of plant, animal, and human health, scientific researchers from other relevant disciplines, and state administration experts.

The committee has evaluated the equipment, supply situation, and research plans of all research institutions in the country where virus research is carried out. The leaders of these institutions, in cooperation with their staffs, developed proposals for increasing the efficiency of domestic virological research. The committee has also solicited expert tesimonies from 50 researchers. The data acquired in this manner were evaluated, and the committee has formulated a draft proposal. The proposal was debated at the 30 November 1977 academic conference. The report of the committee was finalized on the basis of the draft and the comments made at the conference.

The conference, considering the comments made, as well as the written comments obtained from the state secretary of the Ministry of Health, the state secretary of the Ministry of Agriculture and Food, and the deputy chairman of the OMFB [State Technical Development Committee], basically agreed with the recommendations of the report. Most comments dealt with additions and clarifications, which were incorporated in the final version.

Resolution 7/1978 of the Presidium

1. The Presidium expresses its thanks to the chairman, secretaries, and members of the committee for their high-quality report, and thanks to all researchers who contributed to the report through their expertise.

2. The Presidium approves the major recommendations of the report as outlined below.

2.1. The coordination, the concentration of material and intellectual resources, and the cooperation must be improved significantly in all areas of virus research.

In order to accompoish this, the MTA [Hungarian Academy of Sciences], the MEM [Ministry of Agriculture and Food], and the EuM [Ministry of Health] should jointly ask the appropriate specialist institutions that they debate the possibilities and conditions of the appropriate coordination and cooperation during the 1978-1979 period, so that their recommendations could be implemented in the formulation of the research plans for the 1981-1985 period.

2.2. To allow more effective fight against the viruses, there is a need for improvements in the diagnostic methods in all areas. Among the scientific research projects, efforts aimed at adapting, improving, and spreading of such methods must be emphasized.

2.3. The university teaching of virology must be expanded, and the virological researchers should be utilized in the educational system. Interest in virology must be awakened in scientific student circles. There should be more special virological colloquia in agricultural, medical, and scientific universities. Increased support should be given to virological research activities operating in university centers for the expansion of the work of scientific student circles and special colloquia.

Domestic and foreign study trips should be allowed for experts engaged in studies of plant, animal, and human virology so that they become increasingly proficient in their specialty. In the field of human virology, widespread training should be given to practising physicians to improve the virus diagnostic situation. A framework for training domestic virological assistants should be set up.

2.4. A prime prerequisite for development of virology is a qualitative and quantitative improvement in the domestic supply of experimental animals and locally made starting materials.

- The industrial-scale manufacture of the needed types of nutrient media by the Human Vaccine Manufacturing and Research Enterprise must be set up.

- Calf and cattle serum of the needed quality and in the required amounts must be ensured at Phylaxia Vaccine and Nutrient Works, and the quality of the products made there must be improved.

- The facilities of the Laboratory Stock Animal Breeding Institute must be expanded to permit this institution to supply experimental animals for research. The quick availability of special experimental animals, which are infrequently needed (such as primates and naked mice), must be ensured.

- The procurement of chemicals and base materials must be considerably speeded up. A central virological supply storage facility must be set up. It must hold supplies needed for virological research.

2.5. To bring virus research to the desired level, constructions will also be needed during the next 5-7 years.

- The greenhouse area must be expanded for plant-virological studies in the appropriate research institutions of the MEM, in accordance with the virus-fighting program approved earlier.

- The Department of Virology, presently operating at the Research Institute of Veterinary Medical Sciences of the MTA, should be strengthened in conjunction with its transfer to Debrecen so that it becomes capable of performing much of the basic research needed in conjunction with the animal health problems involving the production of foods of animal origin.

- The plans for the new virological building of the National Institute of Public Health have been completed. The edifice will have a floor area of approximately 25,000 square meters, and it should be constructed during the first half of the Sixth Five-Year Plan period.

This center should be able to supply all human-virological laboratories in the country with reference material and diagnostic means (virus strains, reference sera, antigens, cell lines, cell clones, and so forth). It should also have the prerequisites for producing and studying vaccines and inoculants.

- The human virus diagnostic network of the country must be significantly expanded by establishment of new laboratories, at least in three KOJAL's [expansion unknown], taking the coverage situation into consideration.

2.6. By improving the potentialities of medical basic and applied virology atudies through the much needed staff development and through the provision of equipment, it will be ensured that the results of research are properly implemented in practice. With this goal in mind, properly chosen themes must be more thoroughly investigated on a broadened basis at the Microbiological Research Group of the MTA and the Departments of Virus Research and Vaccine-Analysis of the OKI [National Institute of Public Health].

2.7. In developing the plant-virological studies, use must be made of the latest plant-physiological, plant-genetical, and plant-biochemical research results and methods.

- Tissue culture, tip meristema growing;
- Heat-therapeutic virus killing;
- Immunization with weakened virus strains;
- Selection and mutation in single-cell cultures;
- Hybridization by means of protoplast fusion;
- Resistance improvement, primarily by means of species hybridization.

Adequate support for these themes must be made available, including staff development, within the plans of the Szeged Biological Center of the MTA and the appropriate research institutions of the MEM.

2.8. In the field of applied animal-health studies, the facilities of the institutions of animal health, of the virus-producing sections of Phylaxia, and the Institute of Testing Veterinary Vaccines must be expanded. This will create the basic prerequisites for modern diagnostic and vaccine-producing development. In these large institutions it is necessary to institute studies dealing with the virus-infection combating in large-scale animal breeding establishments. In order to provide for specialized advanced training in virology, a section with at least five virologists should be set up within the University of Veterinary-Medical Sciences.

2.9. In order to reduce the damage caused by animal diseases of viral origin and to improve materially the quality of the vaccine production, we need to produce more effective, more highly concentrated, and better purified virus vaccines. We must make sure as soon as possible that the live-virus vaccines are made with SPF-quality base materials (eggs, primary tissues, and sera), so that the spreading of disease-causing agents through these vaccines comes to a stop.

2.10. Consideration should be given to the establishment of a general virological research institution to meet the expected long-range need for virus research. The tasks of this institution would include basic studies aimed at more effective measures against plant, animal, and human viruses, as well as the systematic advanced training of experts engaged in the field of applied virology. The research goals of the institution must be coordinated with the tasks of the other virological research establishments in the country.

It is advisable to establish such a central institution through the expansion of an already existing relevant research institution. Taking our financial resources into consideration, and considering our staff shortage, it seems that this institution cannot be established before the late 1980's. This proposal must be examined, and a decision reached, when the Sixth Five-Year Plan is discussed.

3. The Presidium deems it desirable to give more publicity in the press to matters concerning the status and problems of virus research.

2542
CSO: 2502

ROMANIA

RELATIONSHIP BETWEEN ECONOMIC GROWTH, ENERGY CONSUMPTION

Bucharest ENERGETICA in Romanian No 10, Oct 77 pp 387-390

/Article by Florin Alexe, assistant at the Bucharest Polytechnical Institute, Faculty of Power Engineering, Department of Electric Power Stations: "Interdependence of Economic Development and Energy Consumption"/

/Text/ The rapid increase of the world's population and the need of raising the living standard (or the desire to make greater profits in the capitalist economy) and of closing the gaps between the various countries are making rapid economic growth increasingly necessary, especially in the developing countries /1, 2/. This entails a greater per capita and total energy consumption, while the energy reserves are limited and increasingly expensive.

There is a close correlation between an economy's developmental level and its consumption of energy resources. For example, when we compare the shares of the various regions of the world in the gross world product (PMB) and in the total energy consumption (CE), and their per capita gross product (PNBL) with their per capita energy consumption (CEL), we find some close correlations among these indices (see Table 1 /3/).

There is an equally close interdependence between the economic growth rate and that of energy consumption (see Table 2 /2/).

If we convert the data in Tables 1 and 2 to graphs wherein the per capita gross national product is noted on an abscissa, we obtain Figures 1, 2 and 3. (1).

Figures 1 and 2 also include the points denoting the levels of the respective indices in Romania in 1972 ($935 per capita, 2,912 kg of cc /conventional fuel/ per capita, and 3,114 kg of cc per dollar) /1/, /4/.

Figure 2 shows the linear function and Figures 1 and 3 the parabolic functions approximating the best ratio between the indices on ordinates and the PNBL on an abscissa. The method of the minimum average quadratic error was used to determine these functions, the proportion of each point being equal to the respective region's share in the PMB.

Table 1

Values of CEL, Gross National Product per Capita, and Specific Energy Consumption per Dollar of PNB, in Various Countries and Regions

Regiunea 1)	Ponderea regiunii 2) în %		PNBL 3) $/loc	CEL 4) kgcc/loc	5) CEL/PNBL kg c.c/$
	PMB	CM			
6) America de Nord	33,3	37,3	3437	9524	2,771
7) Europa de Vest	26,1	20,4	1685	3256	1,932
8) Țări socialiste Europa + URSS	19,1	22,9	1269	3778	2,977
9) Asia (țări nesocialiste)	10,3	7	210	354	1,686
10) America Latină	4,3	3,6	395	821	2,0785
11) Asia (țări socialiste)	3,7	5,9	111	441	3,973
12) Africa	1,9	1,7	139	298	2,144
13) Oceania	1,3	1,1	1613	3563	2,209
14) TOTAL MONDIAL	100,0	100,0	674	1668	2,4747

Table 2

Average Overall Economic Growth and Growth of CE in Various Regions in 1950-1972. (When the Growth Rate of CE was Unaffected by the Petroleum Price Rise)

1) Regiunea	15) Rate medii de creștere (1950–1972), %		3) PNBL $/loc.	16) Rata de creștere a CE / Rata de creștere a PNB 17)
	CE	PNB		
6) America de Nord	3,2	3,8	3437	0,84
7) Europa de Vest	4,4	4,8	1685	0,92
8) Țări socialiste Europa + URSS	6,9	5,6	1269	1,23
18) Asia	9,0	6,8	147	1,32
10) America Latină	7,6	4,9	395	1,55
12) Africa	5,4	4,4	139	1,23
13) Oceania	5,0	4,2	1613	1,19
14) TOTAL MONDIAL	5,1	4,8	674	1,06

1. Region
2. Share of region, in %
3. PNBL in dollars per capita
4. CEL in kg of cc per capita
5. CEL over PNBL in kg of cc per $1
6. North America
7. Western Europe
8. European socialist countries, USSR
9. Asia (nonsocialist countries)
10. Latin America
11. Asia (socialist countries)
12. Africa
13. Oceania
14. World total
15. Average growth rates (1950-1972), %
16. Growth rate of CE
17. Growth rate of PNB
18. Asia

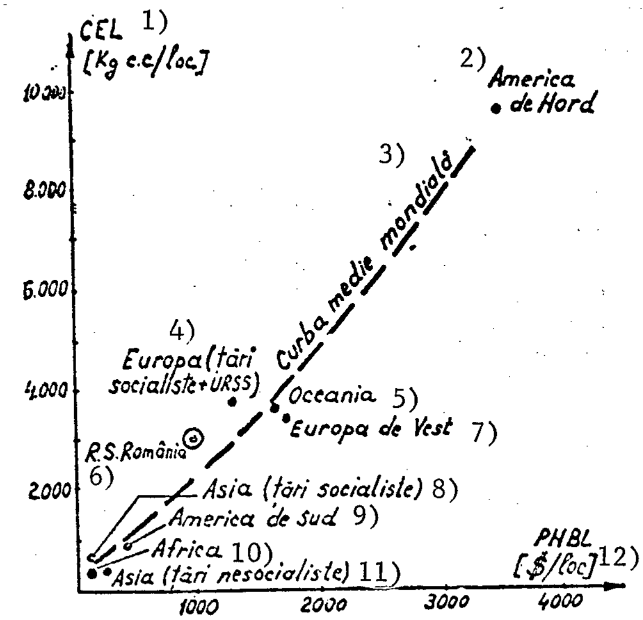

Figure 1. Variation of CE with PNBL in Various Regions of the World

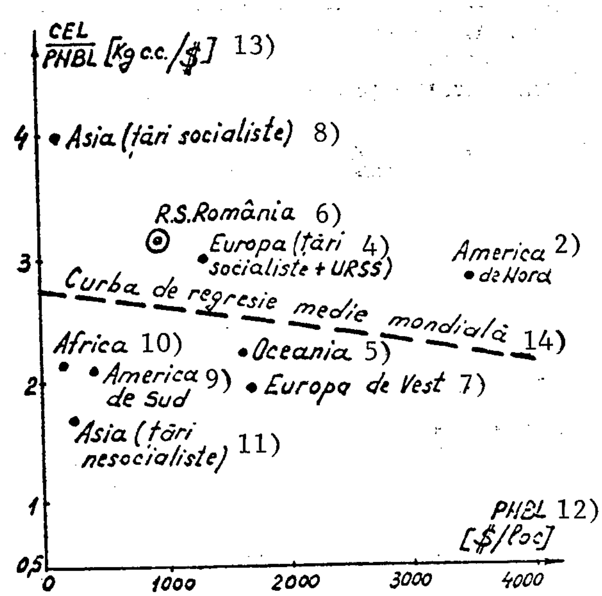

Figure 2. Variation of Specific CE per Dollar of GNP with PNBL

1. CEL in kg of cc per capita
2. North America
3. Average world curve
4. Europe (socialist countries, USSR)
5. Oceania
6. Romania
7. Western Europe
8. Asia (socialist countries)
9. South America
10. Africa
11. Asia (nonsocialist countries)
12. PNBL in dollars per capita
13. CEL over PNBL in kg of cc per $1
14. Average world curve of regression

We obtained the following equations:

$$\text{CEL} = 253{,}25 + 1{,}632 \cdot \text{PNBL} + \frac{\text{PNBL}^2}{3264{,}7} \qquad (1)$$

$$\left(\frac{\text{CEL}}{\text{PNBL}}\right) = 2{,}7328 - 0{,}000136 \cdot \text{PNBL} \qquad (2)$$

$$\frac{\text{Rata CE}}{\text{Rata PNB}} = 1{,}473 - \frac{\text{PNBL}}{270} + \frac{\text{PNBL}^2}{18650} \qquad (3)$$

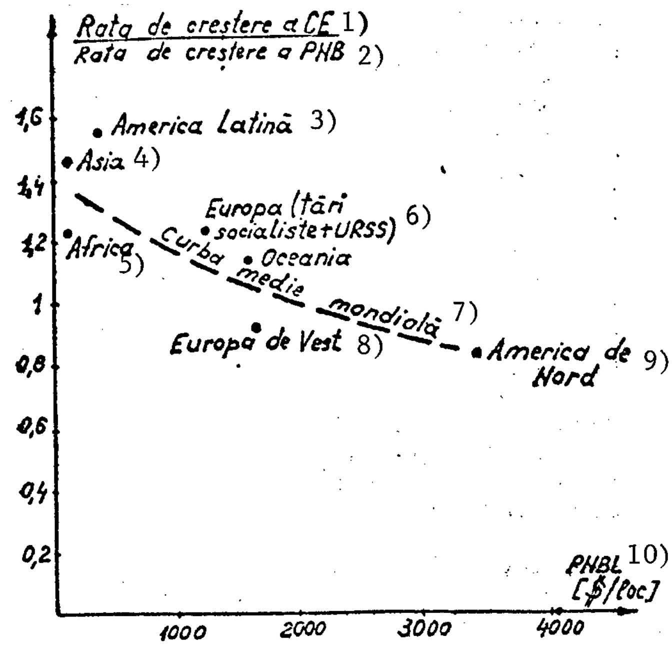

Figure 3. Ratio Between the Growth Rate of Energy Consumption and the Overall Economic Growth Rate, in Various Areas of the World

1. Growth rate of CE
2. Growth rate of PNB
3. Latin America
4. Asia
5. Africa
6. Europe (socialist Countries and USSR)
7. World average curve
8. Western Europe
9. North America
10. PNBL (dollars per capita)

These graphs brought out the extent and nature of the dependence of the CEL upon the level of economic development and enabled us to draw some helpful conclusions for purposes of "relaxing" this dependence and obtaining the fastest possible growth rate with the slowest possible CE.

Figures 1 and 2 indicate that a number of countries including Romania are far above the line of regression. This is a disadvantage, especially in the countries importing fuel and energy. Comparison of the Romanian indices with the

world ones indicates the necessity of making energy consumption more effective by reduction of specific inputs, improvement of technologies, and rational management of fuels and energy.

As for the variation of the ratios between the CE and PNB growth rates, and of the CE per dollar produced (Tables 1 and 2, Figures 2 and 3), note that the developing and intermediately developed countries show a ratio above 1 (reaching higher values especially in regions with high rates of economic growth) and a CE per dollar produced above the world average, but as their national economies develop the specific CE per dollar produced and the ratio of the growth rates decline, making the CE more effective (2, 3).

In the particular case of Romania (where the CE growth rate in 1950-1972 was about 1.2 times higher than that of the world economy, reaching a specific CE of 3,114 kg of cc per dollar, or 1.26 times greater than the world average), efficient measures were adopted to make rational use of fuels and energy: In 1972-1925 for example the CE growth rate dropped practically to that of economic growth. Nevertheless these measures are not sufficient in the long run.

If Romania is to reach a point on the line of regression in Figure 2 by the end of the 1975-1990 period (when a rapid growth rate of the PNBL of about 8 per cent will be maintained), the actual value (4) of the PNBL will have to be some $3,700 and the average CE will have to be about 9,800 kg of cc per capita, or 2,223 kg of cc per dollar. For this purpose the average CEL growth rate will have to be 5.8 percent and the ratio between the two rates 0.725, namely below 1 and even lower than the value in North America (see Table 2) (5). Of course a sharp reduction of the CEL growth rate could interfere with the overall economic growth rate and the rise of the people's living standard, so that the CE growth rate should gradually drop to about 6.3 percent in 1976-1980, 5.9 percent in 1981-1985, and 5.5 percent in 1986-1990. In this way Romania can attain a high value of the PNBL and a highly effective use of fuels and energy in 1990.

These objectives can be accomplished in the socialist Romania of 1990 through continued application of some well-advised measures like those provided in the recent party and state documents (6):

- Use of new technologies to reduce specific energy inputs in industry;

- Expansion of combined production of electric power and heat in thermal electric power stations and centralized delivery of heat;

- Recovery of the energy losses in industry in general and in the chemical, metallurgical and by-product coke industries in particular;

- Direction of the economic growth effort toward industries (or technologies) with low specific CE and high productivity (the electronics industry, automation elements etc.);

- Reduction (or elimination) of exportation of products the costs of which include heavy inputs of energy and raw material and little skilled labor (aluminum ingots, raw steel rolled products etc.);

- Concentration of manufacture of small and medium components and subassemblies requiring high CE (small and medium cast parts for example) in big units, permitting high productivity and recovery of residual energy.

To be sure this article has its imperfections (inherent in any long-range forecasting), but its conclusions can be improved in the course of the period under consideration by careful analysis of national and worldwide economic evolution.

The main purpose of the article is not to determine fixed policies to be followed (for there is certainly a multitude of economic and energy policies that can lead to the results anticipated here), but to bring out the importance that must be attached henceforth to the conservation of fuel and energy and to warn against further increase in Romania's CE at the same rate as the world's economic growth.

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FOOTNOTES

1. The figures in Tables 1 and 2, converted to graphs in Figures 1, 2 and 3, refer to the period before the energy crisis (Table 1 refers to 1972 and Table 2 to 1950-1972). The more recent figures are incomplete and contradictory and some are questioned in various statistical yearbooks. Moreover the energy crisis caused great discontinuities in the evolution of the of the CEL and PNBL as well as the economic recession in a number of developed capitalist countries, so that the more recent figures are liable to be insignificant. It would be useful to update these statistics after an economic and energy stabilization, which is being delayed in the western countries with a large share in the PMB and CE.

2. One of the main reasons why the developing countries show high specific CE per unit of PNB as well as growth rate ratios above 1 (CE rate per PNB rate) is their lack of peak modern technologies with low CE and the industrially advanced nations' reluctance to transfer technology to them.

   Note that a large part of the developed countries' PNB's come from services and economic sectors with low CE such as finance and banking, trade, tourism, export of capital and know-how, etc. while most of the developing

countries are concentrating their industrialization on the chemical and heavy industries, which are both large consumers of energy.

Another, more important reason of the developing countries that have chosen a noncapitalist development is the need of rapid improvement in their living standards.

3. The figures on CE and its growth rate refer to consumption of primary energy. The world consumption of electric power has a higher growth rate, tending to increase the proportion of electric power in the world's energy reserve. This process is more intensive in the developed countries, where the consumption of primary energy to produce electric power amounts to 25-30 percent of the total consumption.

4. The per capita value of the PNBL of about \$3,700 in the socialist Romania of 1990 is based upon the assumption of an annual growth rate of the PNBL of 8 percent and upon the provisions of the RCP Program, which estimates a per capita national income of about \$3,500-\$4,000 in 1990.

5. In the light of Footnote 3, the growth rate of the per capita electric power consumption in this period must be kept as close as possible to the growth rate of the PNBL, so that the difference between the two growth rates will meet the requirement for a higher proportion of electric power in Romania's energy reserve. So far from wasting primary energy, this energy policy will permit major savings and better use of our domestic resources of inferior fuel, thanks to the great productivity of transmission and use of electric power.

6. See also the recent decree on energy conservation.

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END